National Weather Service Omaha/Valley, NE
Winter 2013-14 Outlook

November 21, 2013

Serving eastern Nebraska and west central to southwest Iowa

The National Weather Service's winter season outlook for December 2013 through February 2014 indicates equal chances of above, near, or below normal temperatures (Fig. 1a) and precipitation (Fig. 1b) for much of the Midwest and Plains, including eastern Nebraska and west central to southwest Iowa. In other words, there are no clear, strong, or reliable climate indicators that favor one category over the others for temperature or precipitation.

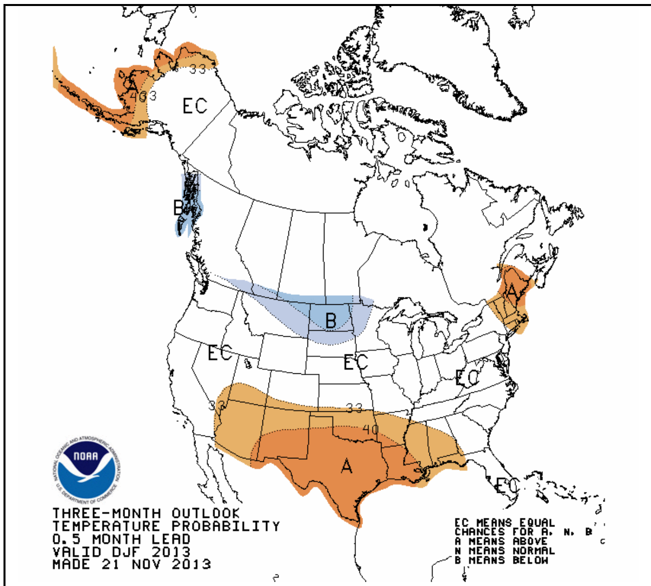

Figure 1a. Three-month temperature outlook for winter 2013-2014, December-January-February.

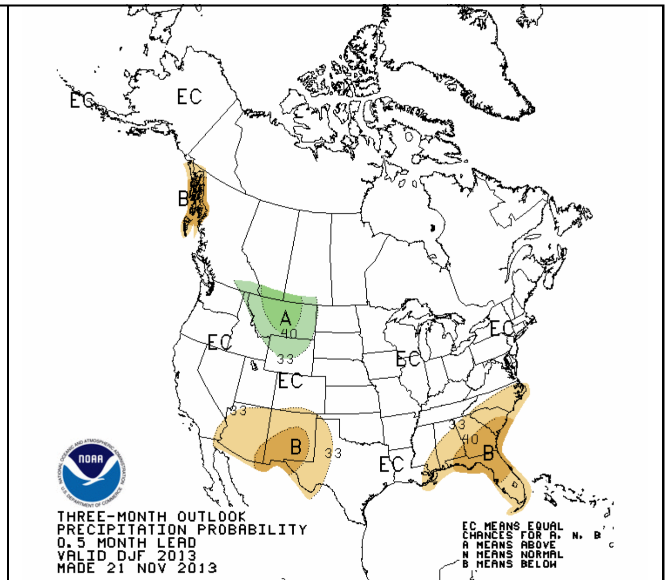

Figure 1b. Three-month precipitation outlook for winter 2013-2014, December-January-February.

The NWS Climate Prediction Center's (CPC) outlook projects the likelihood that the average temperature and total precipitation for the three-month period will fall into the above, near, or below normal categories. Climatologically speaking, each category has a one out of three chance of occurrence. So forecasters look for climate indicators that suggest a deviation from the norm and adjust the probabilities accordingly. This outlook does not directly address the character of the winter, e.g., stormy, quiescent, snowy, icy, and so forth.

Climate Indicators and Tools

There are a number of climate indicators and various types of tools that CPC forecasters monitor and assess when creating climate outlooks. Some of these indicators and tools are described below, with comment included where they may impact the weather this winter. Like any weather forecast, various tools are weighted to varying degrees based on current and anticipated conditions. Some tools can provide conflicting signals, and it is the forecasters' challenge to assess and resolve these situations as part of the outlook process.

El Niño – Southern Oscillation (ENSO) – The phase of ENSO – El Niño, La Niña, or neither (neutral) – affects weather patterns during the winter across the United States. Average weather patterns for each of these phases, termed composites, are an important forecast tool. Basically, average weather conditions associated with each of these phases have been developed as shown in figure 2 for neutral conditions. Since the ENSO cycle only explains part of the total solution for a winter outlook, it is only one of several tools that are used in developing the outlook.

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The ENSO forecast for this winter is depicted in figure 3. Neutral conditions are most likely (note probabilities shown by the bar graphs) which result, on average, in a tendency toward the pattern indicated in figure 2. Note, however, the ENSO neutral relationship to U.S. weather is weaker than with El Niño or La Niña, and other teleconnections such as the AO and NAO have a greater impact in ENSO neutral years. The ENSO cycle is fairly predictable several months in advance, and this aspect of the oscillation, along with its influence on winter weather in the U.S., is why it is an important forecast tool.

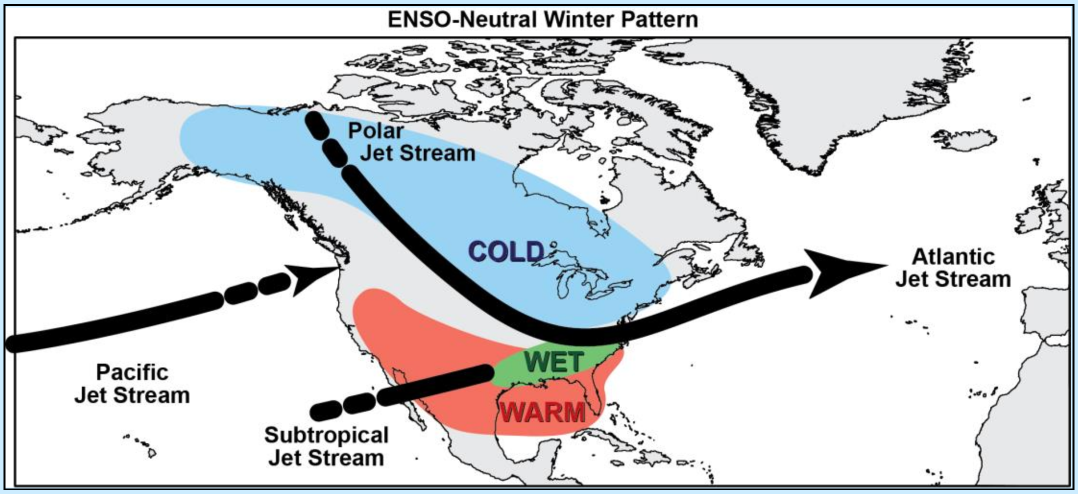


Figure 2. This figure from Higgins et al (J. Climate 2002) depicts the composite weather pattern based on 18 ENSO neutral winters during January-February-March from 1950-1999. Note that it does not include data since 2000.

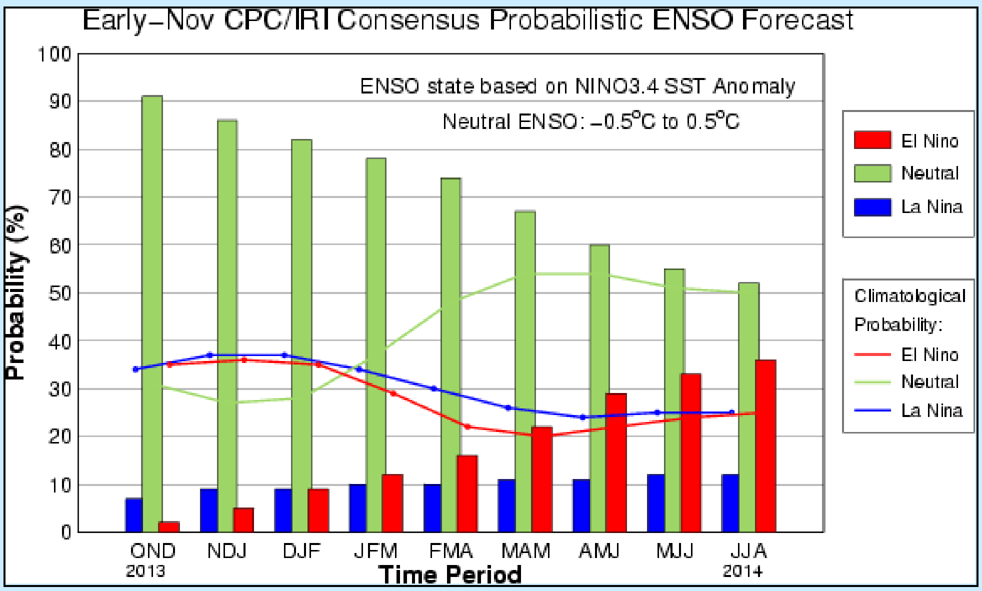


Figure 3. The probability of ENSO phase through summer 2014 (bar graph) and the climatological probability (line graph).

Arctic Oscillation / North Atlantic Oscillation (AO / NAO) – The Arctic Oscillation (AO) is an atmospheric circulation pattern in which pressure over the polar regions varies in opposition to that in the mid-latitudes (low pressure near the pole – high pressure in the mid-latitudes and vice versa). The North Atlantic Oscillation (NAO) is essentially a regional aspect of the AO. As shown in figure 4, the positive phase on the left is reflected in the U.S. by warmer than normal temperatures as winter storms and associated cold air are quickly pushed off to the east. In contrast, the negative phase (right in figure 4) is characterized by a pattern which allows cold air and storms to dump into the U.S., resulting in colder than normal temperatures.

The challenge with the AO/NAO system is that it is generally only predictable for the next few weeks. Thus it is not a feature of the climate whose frequency or impact can be well anticipated months in advance, and thus it is not yet a reliable forecast tool for seasonal forecasting. However, it can be useful in forecasting weather patterns in the next few weeks.

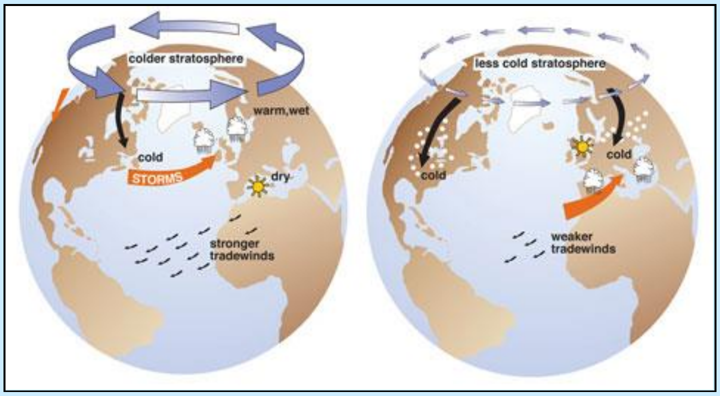


Figure 4. The positive phase (left) and negative phase (right) of the Arctic Oscillation.

Madden-Julian Oscillation (MJO) – The Madden-Julian Oscillation is an intraseasonal (within a season) fluctuation or wave occurring in the global tropics characterized by eastward movement of regions of enhanced and suppressed topical rainfall, primarily over the Indian and Pacific Oceans. The location and strength of these stormy areas can actually impact circulation patterns in the mid-latitudes via its influence on the jet stream, and thus it can impact weather in the U.S. (figure 5, for example). In a winter with a neutral ENSO, the MJO can be the most significant tropical driver of our winter climate. With a cycle of 30-60 days, it can result in changeable and sometimes energetic weather over the U.S., and it would be reasonable to expect that to be the case this winter. However, the MJO is only predictable for the next few weeks. So while the MJO *may* impact the character of weather this winter (variable weather – alternating periods of storminess and cold air outbreaks), it is not a useful tool for assessing the winter seasonal mean temperature and total precipitation. In other words, all that variable weather could average to near normal.

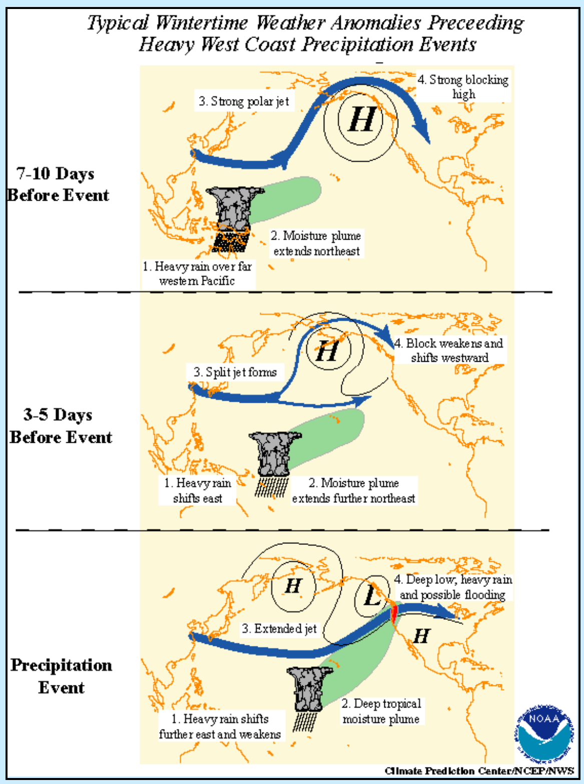


Figure 5. Typical wintertime weather anomalies preceding heavy West Coast precipitation events.

Natural variability – that part of the climate system which is essentially random noise and not predictable. This includes that portion of weather not explainable by other climate indicators. It can be, at times, a significant or the primary factor in our weather. Natural variability is a leading cause of forecast "error" in climate outlooks and is always a factor in climate outlooks.

Trend – Reflects the linear change in temperature and precipitation from year to year and persistence of observational tendencies for a given season and location. This approach, known as optimal climate normals (OCN), is simply the arithmetic difference between the average conditions for the last 10 years for temperature, and 15 years for precipitation, and 30 year normal of each. It capitalizes on long-term trends and multi-year regime effects. Our annual winter season trends in the last 10 years have shown no tendency in average temperature, but the last 15 years have shown a wetter signal for precipitation from western Iowa into northeast and east central Nebraska (figure 6). This type of information for the last 10-15 years is broken down into three-month seasons, and then the skill of the OCN method is determined so forecasters know how reliable this technique is. This is an important point, i.e., the forecaster only utilizes that part of the guidance where skill has been demonstrated.

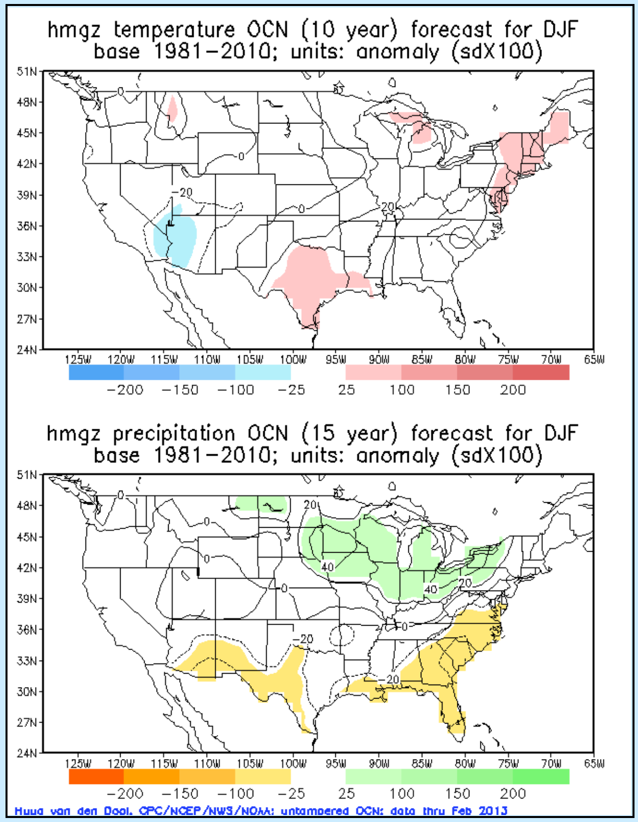


Figure 6. Climatological trends for winter during the past 10-15 years for temperature and precipitation respectively.

Pacific Decadal Oscillation (PDO) – a cycle of sea-surface temperature anomalies in the North Pacific, similar in some respects to ENSO, except that the PDO cycle is 20-30 years instead of 6-18 months, and its impact on the climate in the U.S. is not as significant as ENSO. The PDO displays both a cold phase and warm phase (figure 7). Currently we are in a cold phase (right in figure 7).

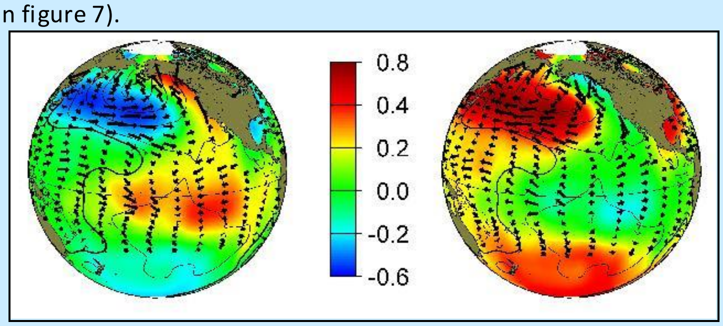
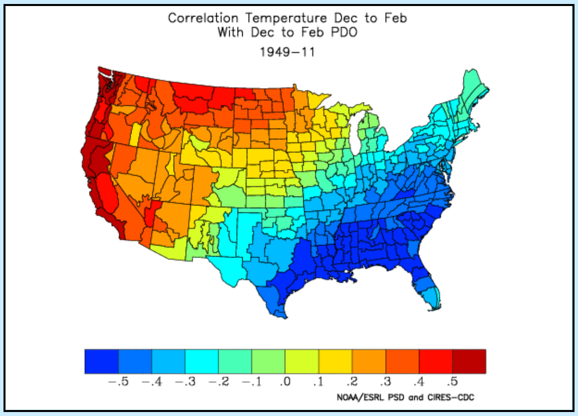


Figure 7. The warm phase of the PDO (left) and cold phase (right). Note the sea surface temperature anomaly upon which the phase is determined is not the large anomaly in the North Pacific, but rather the smaller anomaly along the Alaskan-Canadian coastline.

In some parts of the country in an ENSO neutral season, the PDO may have some impact. Part of the apparent predictability of the PDO in the U.S. is tied to its relationship with ENSO, so in an ENSO-neutral year, the PDO may project a weak signal in the U.S. that may be of use in limited areas. This is not the case in Nebraska and Iowa, as shown in figure 8 for temperature and precipitation, which both show poor correlation between the PDO phase and those parameters.



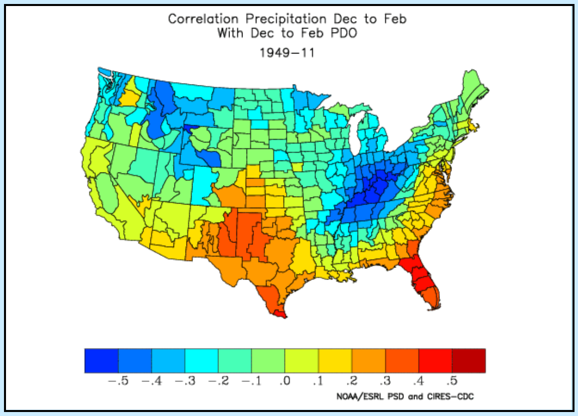


Figure 8. Correlation of winter season temperature (left) and precipitation with the PDO. Values less than +/- .3 are poorly correlated, +/- .3 to .5 weakly correlated, and greater than +/- .5 moderately correlated. The areas where there could be some useful signal are limited to the West Coast and southeast U.S. for temperature, and for just a few spots in the northern Rockies, Ohio Valley and Florida for precipitation.

Climate Forecast System (CFS) and other numerical models – A recent major upgrade to the NWS's Climate Forecast System (CFS) has pushed numerical models and their ensemble output into the forefront as a tool used in generating climate outlooks. Other meteorological services, including Canada and those in Europe, also have numerical models similar in application to the CFS.

While there are some similarities between climate models and those used in weather forecasting, there are some important differences. Rather than assessing the details of a daily forecast for a monthly or three-month time frame, the output from these models is viewed in terms of weekly, monthly or seasonal averages or totals of temperature or precipitation or other variables. Multiple versions of these models are run, known as an ensemble, which result is slightly different outcomes. Assessing the variety of outcomes aids forecasters when determining the likelihood of various forecast scenarios the models may signal. In other words, the model is used to help identify the large-scale signal and trends which are important for climate outlooks, while de-emphasizing the minor details which are important in daily weather. Thus while weather forecasters focus on almost hour-to-hour changes in their forecast models, climate forecasters tends to ignore those details as noise (or natural variability) and instead focus on longer term, large-scale signals and how they relate to the other climate indicators.

Statistical Tools – Various statistical tools are used which, for example, correlate patterns of surface temperature and precipitation based on past weather, sea-surface temperatures and 700 mb heights. Other tools may consider soil moisture or snow cover. In recent time, the skill of numerical models has equaled and even exceeded that of the statistical tools at times.

Analogs – While analogs are useful forecast tools for synoptic-weather forecasting, e.g., at NWS's Storm Prediction Center and the St. Louis University CIPS program, they are not generally used for long-range seasonal forecasting. The difference between the two uses is that many, many observations are needed to develop meaningful statistical relationships. So while each new day is another synoptic data point, it takes three-months to generate a seasonal climate outlook data point. Given the range of variables involved in a seasonal forecast, we simply do not have enough observed data points to develop statistically significant or reliable forecasts with this tool in the seasonal time frame.

For more information, visit the NWS Climate Prediction Center at http://www.cpc.ncep.noaa.gov/.